

This lesson is part of a larger, comprehensive school garden guide called **Minnesota School Gardens: A Guide to Gardening and Plant Science** developed by Minnesota Agriculture in the Classroom in 2013. The entire guide is available at www.mda.state.mn.us/maitc.



Grade

Elementary K-5

Materials/Preparation

- ☐ Handout A – Yo Seeds, Wake Up! – one per student
- ☐ Seeds (suggested: beans, mung beans, sunflowers)
- ☐ Writing instruments
- ☐ Plastic bags
- ☐ Paper towels
- ☐ Refrigerator

optional

- ☐ *Frog and Toad Together* by Arnold Lobel

Fun Fact

Zucchini is sometimes called Italian squash, green squash, or summer squash. Zucchini seeds are soft and edible.



Yo Seeds, Wake Up!

Minnesota K-12 Academic Standards

Science	0.1.1.2 2.1.1.2 3.1.1.2 5.1.1.2	Scientific inquiry is a set of interrelated processes incorporating multiple approaches that are used to pose questions about the natural world and investigate phenomena.
Language Arts	3.6.7.7	Conduct short research projects that build knowledge about a topic.
Language Arts	4.6.7.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
Language Arts	5.6.7.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Summary/Overview

Students examine ideas about what seeds need to sprout.

Garden Connection

Oxygen, water, and proper temperature are required for seeds to begin growing.

Background Information

You can hold 100 radishes in one hand, 1,000 carrots in the other, and a wildflower garden in your front pocket — for in every seed lives a tiny plant, or embryo, complete with a leaf, stem, and root parts.



The seed coat protects the embryo. A temporary food source nourishes (“feeds”) the embryo, either as an endosperm packed around the young plant or stored in special leaves called cotyledons. Most seeds are either monocots, having one cotyledon, or dicots, with two. Seeds remain inactive until conditions are right for them to begin to grow, or germinate.

All seeds need oxygen, water, and the proper temperature range in order to germinate. Some seeds require light; others require darkness. Oxygen and moisture, initially taken through the seed coat and later by the root, help the seed get energy from its food supply. Different types of seeds have specific temperature needs and preferences for germination. Some require warmer temperatures — 70-to-75 degrees Fahrenheit is ideal for tomatoes — and others germinate better in cool temperatures — 40-to-65 degrees Fahrenheit is ideal for lettuce. Many seeds also require the proper light conditions to germinate. Some require light to germinate and others are inhibited from germinating by light.

When a seed is exposed to proper conditions for germination, water is taken in through the seed coat. The embryo’s cells begin to enlarge and

the seed coat breaks open. The root emerges first, followed by the shoot, which contains the stem and leaves.

Our treatment of seeds during germination affects their chances of survival. If seeds (particularly small ones) are planted too deeply, the young plants can use up their food reserves before they ever reach light and begin to make their own food. If planted in soil that's too dry, seeds may not get the necessary moisture to germinate. Soaking wet soil, on the other hand, may prevent seeds from getting oxygen, or may cause them to rot.

Objectives

- To predict what factors will affect seeds' sprouting.
- To understand that certain factors affect seeds' sprouting.

Procedure

Interest Approach

Pass some seeds around the classroom. Ask: Do you think these seeds are alive? Why or why not? How could we find out if they're alive? If they are alive, what do you think will make them start to grow? Explain that when seeds begin to grow, we call it 'sprouting' or 'germinating.' As a class, brainstorm a list of factors students think seeds need to sprout. List them on a class chart.

Optional: Read the story called "The Garden" in *Frog and Toad Together*. After reading the story, add Toad's ideas about how to "wake up" seeds on the class chart. Discuss some of Toad's ideas. Ask: "Do you think yelling might wake seeds up?" Were Toad's ideas the same as or different from those of the student?

Summary of Content and Teaching Strategies

Have the class test some of the ideas from the chart to find out what helps seeds sprout. Use large seeds such as beans or, if you want to have edible sprouts, try mung beans or sunflowers. (Alfalfa and radish seeds also make nice edible sprouts, but may be too small for young students to handle.)

Week 1 – Moisture

If water was one of the factors mentioned by students, ask: "Do you think seeds need to be moist or dry to sprout?" What have students seen that makes them believe this? List the headings "Moist" and "Dry" on the

board, and have students suggest how they could try and sprout seeds in different conditions (e.g., by using sponges, paper towels, or soil).

If none of the students' ideas resembles the experimental setup below, suggest it as another option. As a class, choose several setups to test both moist and dry conditions.

Ask: "How will we decide when seeds have sprouted?" Tell students they must decide together what constitutes 'sprouting' in their experiments. Is it when they see the root or when it's two centimeters long?

Using Handout A, have students draw setups for both moist and dry conditions. Each day, students should fill in the total number of seeds that have sprouted to date.

At the end, have students chart on a bar graph the number of seeds sprouted in the setup. Guide their thinking with questions such as, How did seeds seem to sprout best? How did you decide when they'd sprouted? Why do you think we tried sprouting seeds in different conditions? What factors, other than the amount of water, might have affected whether seeds sprouted? (e.g. some may have been in a warmer spot.)

What to expect: Within five days, most of the moist seeds should have sprouted, but not the dry seeds. If the students' setups included submerging seeds in water, they may find that seeds fail to germinate when too wet.

Week 2 – Temperature

If students mentioned temperature as a factor to help seeds sprout, discuss: Do you think seeds might sprout better in warmer or cooler temperatures? What have you ever observed that makes you believe that? How do you think we should set up a test to see whether warm or cool conditions help seeds sprout? List student suggestions for the setup under the headings "Warm Temperatures" and "Cool Temperatures."

Suggest the setup below (or on the next page) as another option. As a class, use several of the suggested setups to test how temperature affects seed germination.

Ask: "From what we've already learned, do you think we should keep the seeds moist or dry from this experiment? If the cool-temperature seeds are in a dark refrigerator, where should we place the warm-temperature seeds?" Remind students that they must give both sets of seeds the same conditions except for temperature, to have a fair test. If we kept one set

of seeds in cool, dark conditions and one in warm, light conditions, how would we know whether it was temperature or light that affected sprouting? The warm-temperature seeds, therefore, should also be in a dark place.

Students keep track of their investigations, as in Week 1, using the worksheet. Have them chart the number of seeds that sprouted after five days under both warm and cool conditions. Ask: "How did seeds seem to sprout best? What do you think would happen if we tried sprouting seeds in warm, dry conditions? In cool, moist conditions?"

What to expect: Within five days, you should find seed sprouting is generally improved with moderate warmth and inhibited with cool temperatures. Temperatures at either extreme can inhibit sprouting.

Week 3 – Students' and Toad's Ideas!

Review the suggestions made by the class and by Toad. Have the class vote on one condition, or have small groups each choose one condition to test. Set up investigations similar to Weeks 1 and 2 to determine what other conditions (e.g. light, yelling, fertilizing, singing) help seeds to sprout. Help students think about whether they're conducting fair tests (with one variable).

When all experiments are complete, combine results on a class graph. Ask: "What conditions seemed to be the best for sprouting seeds?"

Review/Summary

Review the following questions with your students:

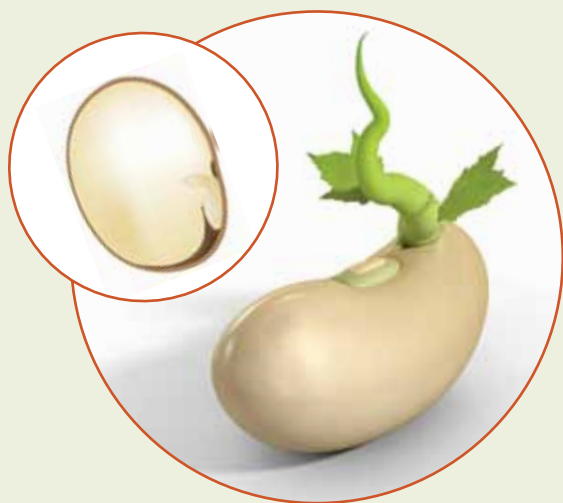
- How did you decide when seeds had sprouted?
- Were you surprised by any of your findings? Which ones?
- If we knew some seeds preferred warmth, could we assume that they preferred very hot temperatures? Why or why not? How could we find out?
- Would you plant bean seeds outside in December? Why or why not?
- What other questions do you have about seed sprouting?

Modifications/Extensions

After reviewing findings, write a class recipe for making sprouts to eat. Grow and taste different edible sprouts. Prepare different sprouted foods (e.g., salads, soups, "hairy" peanut butter sandwiches.)

Play Seedling Tic-Tac-Toe. Divide flat containers into nine squares. Plant one type of seed in each square. The first student to have three germinated seeds in a row wins.

Move the plants from the experiments in this lesson outdoors into your school garden. Observe how large the plant becomes compared to the tiny seed it all started from.



Sources/Credits

Adapted from the National Gardening Association's *Grow Lab Activities for Growing Minds*, second edition, copyright 2009. For information on obtaining a copy of their curriculum, visit www.gardeningwithkids.org.

Name _____



Yo Seeds, Wake Up!

Draw your setups:

Condition:

Condition:

Number of seeds used: _____

How many seeds have sprouted by...

Day 2	
Day 3	
Day 4	
Day 5	

Number of seeds used: _____

How many seeds have sprouted by...

Day 2	
Day 3	
Day 4	
Day 5	

Other Observations:
